Conservation Assessment
for
Tetraphis geniculata Grig. ex Mitt.

Photo by Martin Hutten

13 July 2005

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USDI Bureau of Land Management, Oregon and Washington

Updated by Camille Duncan in February 2010 (Update added Attachment 1: Photos)

Preface:

Converting Survey and Manage Management Recommendations into Conservation Assessments
Much of the content in this document was included in previously transmitted Management Recommendations developed for use with Survey and Manage Standards and Guidelines. With the removal of those Standards and Guidelines, the Management Recommendations have been reconfigured into Conservation Assessments to fit Special Status/Sensitive Species Program (SSSSP) objectives and language. Changes include: the removal of terminology specific to Survey and Manage Standards and Guidelines, the addition of Oregon Natural Heritage Information Center ranks for the species, and the addition of USDA Forest Service and USDI Bureau of Land Management (BLM) Special Status/Sensitive Species status and policy. Habitat, range, and taxonomic information have also been updated to be current with data gathered since the Management Recommendations were initially issued. This document does conform to recently adopted standards for the Forest Service and BLM for Conservation Assessment development in Oregon and Washington.

Assumptions about site management
In the Final Supplemental Environmental Impact Statement (FSEIS) (USDA and USDI 2004a) and Record of Decision (ROD) to Remove or Modify the Survey and Manage Standards and Guidelines (USDA and USDI 2004b), assumptions were made as to how former Survey and Manage species would be managed under Agency Special Status/Sensitive Species policies. Under the assumptions in the FSEIS, the ROD stated "The assumption used in the final SEIS for managing known sites under the Special Status Species Programs was that sites needed to prevent a listing under the Endangered Species Act would be managed. For species currently included in Survey and Manage Categories A, B, and E (which require management of all known sites), it is anticipated that only in rare cases would a site not be needed to prevent a listing…. Authority to disturb special status species sites lies with the agency official who is responsible for authorizing the proposed habitat-disturbing activity." This species was in Category A at the time of the signing of the ROD, and the above assumptions apply to this species' management under the agencies' SSSSP.

Management Considerations
"Management Considerations" are discussed within the "Conservation" section of this document. "Management Considerations" are actions and mitigations that the deciding official can utilize as a means of providing for the continued persistence of the species' site. These considerations are not required and are intended as general information that field level personnel could utilize and apply to site-specific situations. Management of the species covered in this Conservation Assessment follows Forest Service 2670 Manual policy and BLM 6840 Manual direction. (Additional information, including species specific maps, is available on the Interagency Special Status and Sensitive Species website.)

Executive Summary

Species and Taxonomic Group

Tetraphis geniculata Grig. ex Mitt.**,** Bryophyte

Management Status

Tetraphis geniculata is listed as Sensitive on the Region 6 U.S. Forest Service (R6) Sensitive Species List, and is considered a Bureau Assessment species by the Oregon-Washington Bureau of Land Management (http://www.or.blm.gov/isssp/). In Oregon this species is ranked S1, List 2 by the Oregon Natural Heritage Information Center (http://oregonstate.edu/ornhic/data/nonvasc.html). In Washington it is ranked S2 (http://www.dnr.wa.gov/nhp/refdesk/lists/plantrnk.html).

Range & Habitat

Tetraphis geniculata is known from the Russian Far East, Japan, Western and Eastern North America. In the Pacific Northwest it is known from British Columbia, Idaho, Oregon and Washington. *Tetraphis geniculata* occurs on the cut ends and sides of decay class 3 and 4 rotten logs and stumps.

Threats

Direct impacts result in the degradation or destruction of individuals or populations of *T. geniculata*. Because this species is located on down wood, potential direct threats include: damage to the structural integrity of existing occupied logs through recreation or vegetation management actions, removal of the logs for placement in streams, or prescribed or wildland fire. Indirect impacts result from vegetation management actions that remove future potential down wood recruitment, and/or result in changes to the microclimate.

Management Considerations

Protect the structural integrity and microclimate around logs with populations of *T. geniculata* during vegetation management, trail or recreational site construction, and in-stream log acquisition.

Directionally fell trees away from occupied sites to minimize disturbance to existing down logs and reduce damage to the canopy.

Avoid designating skid trails in the vicinity of down log concentrations to minimize disturbance to logs.

Encourage leaving hazard trees felled for safety reasons or create additional down logs on site to provide future substratum for *T. geniculata*.

Consider bucking felled retention logs into sections over 3 m long to provide future substratum for colonization.

Avoid firewood cutting within occupied sites.

At occupied sites, if a large down log must be impacted by the project, consider cutting a passage in the log at angles and leaving the cut section adjacent to the existing log.

Research, Inventory, and Monitoring Opportunities
What is the southern extent of the range of *T. geniculata*?

How long can the species persist at a site without recruitment of new substrates?

What are the vectors for propagule dispersal?

Why is *Tetraphis pellucida* more common than *T. geniculata* in the Pacific Northwest when both species have seemingly identical habitat requirements and reproductive biology?

How does *T. geniculata* respond to a created edge in the vicinity and how rapid is the response, if any?

How quickly does habitat recover to a colonizable condition after a disturbance?

Monitor sites where mitigation has been applied to determine efficacy of the measure.

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Introduction

Goal

The goal of this Conservation Assessment is to summarize existing knowledge regarding the biology and ecology of *Tetraphis geniculata*, threats to the species, and management considerations to provide information to line managers to assist in the formation of options for management activities. This species is of concern due to very limited distribution within the Pacific Northwest. Federal management for this species follows Forest Service Region 6 Sensitive Species (SS) policy, and/or Oregon/Washington Bureau of Land Management Special Status Species (SSS) policy.

For Oregon and Washington BLM (OR/WA BLM) administered lands, SSS policy details the need to manage for species conservation. Conservation is defined as the use of all methods and procedures that are necessary to improve the condition of SSS and their habitats to a point where their Special Status recognitions are no longer warranted. Policy objectives also state that actions authorized or approved by the BLM do not contribute to the need to list species under the Endangered Species Act.

For Region 6 of the Forest Service (FS), SS policy requires the agency to maintain viable populations of all native and desired non-native wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands. Management "must not result in a loss of species viability or create significant trends toward federal listing" (FSM 2670.32) for any identified SS.

Scope

The geographic scope of this assessment includes consideration of the known and suspected range of the species within the Pacific Northwest. An emphasis of species-considerations is provided for federal lands in Oregon and Washington; however, species-knowledge compiled from non-federal lands is included as it is relevant to the overall conservation of the species. This assessment summarizes existing knowledge of a bryophyte species that is rare throughout its range. A summary of known or suspected threats is listed but may change with time. Management considerations apply to localities, specifically; however range-wide concerns are discussed. The uncertainty caused by management actions for *T. geniculata* is not clearly known at this time. Because there are so few sites in the Pacific Northwest and the majority of these sites are scattered, and historic, any management activities at known sites may increase the uncertainty.

Management Status

Tetraphis geniculata was originally rated under FEMAT, (Thomas et al 1993) and was placed in Categories 1 & 3, and identified as a Protection Buffer species, under the original Northwest Forest Plan Record of Decision (USDA, USDI 1994). In 2001 this species was placed in Category A because it was rare, and pre-disturbance surveys were practical (USDA, USDI 2001). According to NatureServe (2004) the global rank for *T. geniculata* is G3/G4 with a rounded global status of G3. In Oregon it is ranked S1, List 2 by the Oregon Natural Heritage Information Center (2004). In Washington it is ranked as S2 (Washington Natural Heritage Program 2004). Currently, it is on the USFS Region 6

Sensitive Species list and is considered a Bureau Assessment species by the Oregon/Washington Bureau of Land Management.

Classification and Description

Systematics and synonymy

Tetraphis geniculata Girg. *ex* Milde was first described as *Georgia geniculata* (Girg. *ex* Milde) Brockm., but was changed to *T. geniculata* Girg. *ex* Milde. in 1865.

Species Description

Tetraphis geniculata forms small green to brownish-yellow tufts 7-15 mm tall. Leaves are ovate, acute, 1-2 mm long with a costa ending before the apex. Median leaf cells are round to hexagonal, thick-walled, smooth, 8-18 m long. Plants are slightly contorted when dry. Gametophytic characteristics cannot be used to separate this species from *T. pellucida*.

Biology and Ecology

Life History and Reproductive Biology

Tetraphis geniculata is autoicous. The seta is 7-17 mm long, twisted, geniculate near the middle and papillose above the bend. The capsule is narrowly cylindric, yellow-brown, 1.5-3.0 mm long with four large peristome teeth. Sometimes these four teeth will split in the middle and there appears to be more than four teeth. Spores are wind dispersed. Cup-like structures are commonly produced on the top of a sterile shoot and contain numerous multi-cellular disc-shaped asexual gemmae that are dispersed by splashing water. According to Lawton (1971) these asexual reproductive structures are not commonly found in *T. geniculata*, but Crum and Anderson (1981) indicate that they do occur and recent field experience has shown that they are frequently found within the Pacific Northwest.

Range, Distribution and Abundance

Tetraphis geniculata is known from the Russian Far East, Japan, Western and Eastern North America. In the Pacific Northwest it is known from British Columbia, Idaho, Oregon and Washington. In Idaho, it is known from the Traille River area and Lake Pend d'Oreille areas in Kootenai County. In Washington it has been found on the Mt. Baker-Snoqulamie National Forest (in Skagit, Snohomish and Whatcom Counties), the Olympic National Forest (in Grays Harbor, Jefferson and Clallam Counties), and on the Gifford Pinchot National Forest (in Skamania County). In Oregon it is known from only three locations; one on Salem District BLM in Lincoln County, and two on the Mt. Hood National Forest in Multnomah and Clackamas Counties. Because there are historical sites of this species in Idaho and there is potential suitable habitat, it may also occur in eastern Oregon and Washington. *Tetraphis geniculata* is never abundant when found and is usually mixed in with or adjacent to the more common, widespread *T. pellucida*.

Population Trends

Although there are no specific population details for *T. geniculata*, based on the current distribution in the Pacific Northwest, it appears to be reaching the southern edge of its range in northern Oregon. Prior to surveys conducted under the former Survey and Manage Program, *T. geniculata* was not documented from Oregon. As a result of these surveys 3 small populations were found in the northern part of the state and they represent the southern most occurrences of the species in Western North America. In Washington *T. geniculata* is not well distributed, rather there are several small clusters that are scattered on the west side of the Cascade Crest. Interestingly these clusters occur around historic known sites that were revisited. *Tetraphis geniculata* is never abundant when found and is usually mixed in with or adjacent to the more common, widespread *T. pellucida*. Competition from *T. pellucida* and other bryophyte species may be limiting the distribution of this species.

Habitat

In Washington, *T. geniculata* is known from the Olympic National Forest, on large well-decayed logs in old-growth stands of Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*) and Douglas-fir (*Pseudotsuga menziesii*). On the Gifford Pinchot National Forest *T. geniculata* was found on large, legacy logs in cool moist micro-climate areas in stands ranging in age from 59 to 461 years. The two younger stands (59 and 66 years old) had fairly high amounts of red alder (*Alnus rubra*), cottonwood (*Populus trichocarpa*), and big-leaf maple (*Acer macrophyllum*), with some residual conifers present. The overstory canopy tends to be closed. On the Mount Baker-Snoqulamie National Forest all of the sites have been found in mature to late-seral western hemlock stands with large amounts of remnant rotting logs present. According to Schofield (1976) *T. geniculata* occurs from sea level to subalpine elevations.

In Oregon, on the Salem District BLM site (Lincoln Co.) it occurs in a 400-450 year old stand of western hemlock and Douglas-fir. On the Mount Hood National Forest it is known from western hemlock-Douglas-fir-western red cedar (*Thuja plicata*) stands ranging from 68-865 years old. At least one site on the Mt. Hood is in a second-growth stand with remnant overstory Douglas-fir and down logs.

Little is known about the habitat characteristics of the historical sites in Idaho but it is likely that these sites occurred within pockets of forest that are similar to the coastal forests in Washington and Oregon. These “coastal humid disjunct interior forests” occur in Idaho and in eastern Oregon and Washington; therefore it is likely that habitat for *T. geniculata* may occur in these areas.

Tetraphis geniculata occurs on the cut or broken ends or lower sides of large (usually over 15 inches in diameter in Oregon and Washington), decay class three, four and five rotted logs or stumps, and occasionally on peaty banks in moist coniferous forests from sea level to subalpine elevations. It often occurs on the cut end of rotten logs as “pure” populations or mixed in with *T. pellucida*. It is highly unlikely that it would occur mixed in with dense mats often found on the tops of the rotten logs because it appears to need bare wood in order to colonize.

Ecological Considerations

According to Kimmerer (1991, 1991a) dense colonies of *T. pellucida* have more males, produce more sporophytes (with a low spore production rate) and have fewer gemma. Non-dense colonies have more females present, produce fewer sporophytes (with a high spore production rate) and have numerous gemma. A unique characteristic of the subclass Tetraphidae is the ability of the gametophyte to change sexuality from one year to the next (Schofield 2001). This feature may be in response to changes in the density of a colony. Kimmerer (1991) found that sexual reproduction was not significantly correlated with any of the following environmental variables: light, relative humidity, pH, substrate moisture content, elevation, and cover except microtopographic class. Instead she found that sexual reproductive colonies occurred more frequently on the higher parts of the rotten log or stump rather than in a concave area or on a plane surface. Because decaying wood is an unstable and transient substratum, the fitness of *T. pellucida* may be enhanced by its reproductive plasticity. When combined with the density studies, non-dense colonies on open substratum produce more gemma, which supports rapid propagation and provides for a constant genotype. Dense colonies have less open substratum available and sexual reproduction becomes dominant, thus increasing long distance dispersal opportunities. Kimmerer (1991a) found that colonization of bare substrate by gemmae and spores of *T. pellucida* was extremely slow, but shoot establishment was faster with gemma rather than spores. Therefore low-density colonies producing lots of gemma would be more successful in becoming established.

Because *T. geniculata* grows on down logs its distribution and abundance is obviously tied to down log dynamics. Kimmerer, (1993) describes *T. pellucida* (a related species), as "a shifting mosaic of discrete patches of asexual, sexual, or senescent colonies, interspersed with patches of open substrate and competitors". Because *T. geniculata* is vulnerable to competition from other bryophytes, and decaying logs and stumps are transient resources, a constant source of logs with bare patches of wood is necessary to perpetuate the species at a site.

Young stands will differentiate naturally through suppression mortality of smaller trees (Oliver & Larsen 1996). This provides an influx of down logs into the stand but the logs will typically be smaller than desirable for *T. geniculata* habitat. Thinning of the stand will usually reduce input of down logs at this stage of stand development unless it exposes wind-infirm boles. Thinning does have the potential to provide larger trees faster, and consequently larger down logs depending upon how the mature stand is managed.

Large down logs progress through decay classes logarithmically (Maser & Trappe 1984). Progression to decay class 3, when a log may first becomes potential habitat for *T. geniculata*, is fairly rapid. Progression from decay class 3 to 4 is much slower. The rate of decay will be dependent upon: the tree species; the size of the log; what killed the tree; whether it originated as a live tree or a snag; its placement on the ground; and the biotic community around it (Maser & Trappe 1984).

Bryophyte succession upon a log is highly variable and the factors driving interspecific competition are not well understood. In some sites where pleurocarpus mosses dominant the forest floor, they may envelop logs before other species can gain much of a foothold. However, in most cases, large down logs in moist forest habitat support a diverse flora of moss and liverwort species. *Tetraphis* spp. avoid competition by occupying open, recently disturbed, areas of the log. In the Adirondack Mountains in New York, mechanical disturbance to a log that resulted in bare patches of wood would be colonized by *T. pellucida* (Kimmer 1993). The apparent preference of *T. geniculata* for cut or broken ends and lower sides of logs may represent an ability to occupy microsites that few other bryophytes can colonize. Sympatric occurrences of *T. pellucida* and *T. geniculata* on the same log are known to occur throughout its range.

A word of caution, all of Kimmerer's (1991, 1991a) studies were conducted on *T. pellucida*, a widespread and often abundant species, while *T. geniculata* is rare throughout North America and rarely forms dense, pure colonies. Thus the observations that were made for *T. pellucida* may not apply for *T. geniculata.*

Finally, Forman (1962) found that 20% of the herbarium vouchers that he examined were a mix of both *T. pellucida* and *T. geniculata*. Based on the above density studies, dense, mixed colonies may represent a detriment to the success of *T. geniculata*.

Conservation

Threats

There are potentially direct and indirect impacts that may occur to this species. Direct impacts result in the degradation or destruction of individuals or populations of *T. geniculata*. Because this species is located on down wood, potential direct threats include: damage to the structural integrity of existing occupied logs through recreation or vegetation management activities, removal of the log for placement in streams, or fire. Indirect impacts result from vegetation management actions that remove future potential down wood recruitment to provide future substratum for this species, and/or result in changes to the microclimate.

Because bryophytes lack roots and have leaves that are usually only one cell layer thick they are extremely sensitive to desiccation. According to Proctor (1982) some species found in moist habitats are always killed from even slight drying, while other species that have adapted to arid environments can tolerate high temperatures for short periods. It has been demonstrated that the lethal temperatures for moister habitat species are generally around 40º C – 50º C (Proctor 1982). Therefore direct contact with fire or the heat generated by a fire may lead to the loss of individuals.

Conservation Status

Because *T. geniculata* is a species that occupies ephemeral substrates, it is a challenge to meet the objective of providing a reasonable likelihood of persistence of the taxon at that site. Risk to persistence of *T. geniculata* at any given site will depend upon: 1) the structural integrity of existing occupied logs, 2) maintenance of a suitable microclimate, and 3) the potential for future down logs.

Given our limited knowledge about this species, risk to the site from project activities will generally be lessened by maintaining approximately the current conditions.

Putting a small buffer around a single log is unlikely to provide for persistence at the known site unless some provision is made that a will allow for, or at least not diminish the potential for, future recruitment of down logs. Down log recruitment is the stand condition that carries both the most risk and uncertainty. Silvicultural stand treatments typically result in short-term increased chance of windthrow but long-term reduction of the windthrow potential. The likelihood of *T. geniculata* persisting at a site is improved if the short-term risk of windthrow is not likely to be excessive (i.e., conditions in which the entire edge of the stand would be susceptible to blowing over in a single event). It will likewise be improved over the long run if the prescribed stand conditions are not so uniform that the potential for future down log recruitment is minimized.

Known Management Approaches

There were no prior management approaches applied to this species.

Management Considerations

Below are options to consider when managing for site persistence.

Consider protecting the structural integrity and microclimate around logs with populations of *T. geniculata* during vegetation management, trail or recreational site construction, and in-stream log acquisition.

Directionally fell trees away from occupied sites to minimize disturbance to existing down logs and reduce damage to the canopy.

Avoid designating skid trails in the vicinity of down log concentrations to minimize disturbance to logs.
Encourage leaving hazard trees felled for safety reasons or create additional down logs on site to provide future substratum for *T. geniculata*.

Consider bucking felled retention logs into sections over 3 m long to provide future substratum for colonization.

Avoid firewood cutting within occupied sites.

At occupied sites, if a large down log must be impacted by the project, consider cutting a passage in the log at angles and leaving the cut section adjacent to the existing log.

Research, Inventory and Monitoring Opportunities

What is the southern extent of the range of *T. geniculata*?

How long can the species persist at a site without recruitment of new substrates?

What are the vectors for propagule dispersal?

Why is *Tetraphis pellucida* more common than *T. geniculata* in the Pacific Northwest when both species have seemingly identical habitat requirements and reproductive biology?

How does *T. geniculata* respond to a created edge in the vicinity and how rapid is the response, if any?

How quickly does habitat recover to a colonizable condition after a disturbance?

Monitor sites where mitigation has been applied to determine efficacy of the measure.

Definitions

NatureServe G3/4, rounded status of G3: Vulnerable. At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.

Oregon Natural Heritage Information Center S1 Rank: Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or exitirpation, typically with 5 or fewer occurrences.

Oregon Natural Heritage Information Center List 2: Contains taxa that are threatened with extirpation or presumed to be exitirpated from the staae of Oregon. These are often periperal or disjunct species which are of concern when considering species diversity within Oregon's borders. They can be very significant when protecting the genetic diversity of a txon. ORNHIC regards extreme rarity as a significant threat and has included species which are very rare in Oregon on this list.

Site (Occupied) The location where an individual or population of the target species (taxonomic entity) was located, observed, or presumed to exist and represents individual detections, reproductive sites, or local populations. Specific definitions and dimensions may differ depending on the species in question and may be the area (polygon) described by connecting nearby or functionally contiguous detections in the same geographic location. This term also refers to those located in the future. (USDA, USDI 1994). Other terms such as known site, species location, and element occurrence are included in this definition.

Washington Natural Heritage Program S2 Rank: Imperiled because of rarity or because it is vulnerable to extinction or extirpation; typically 6 to 20 occurrences.

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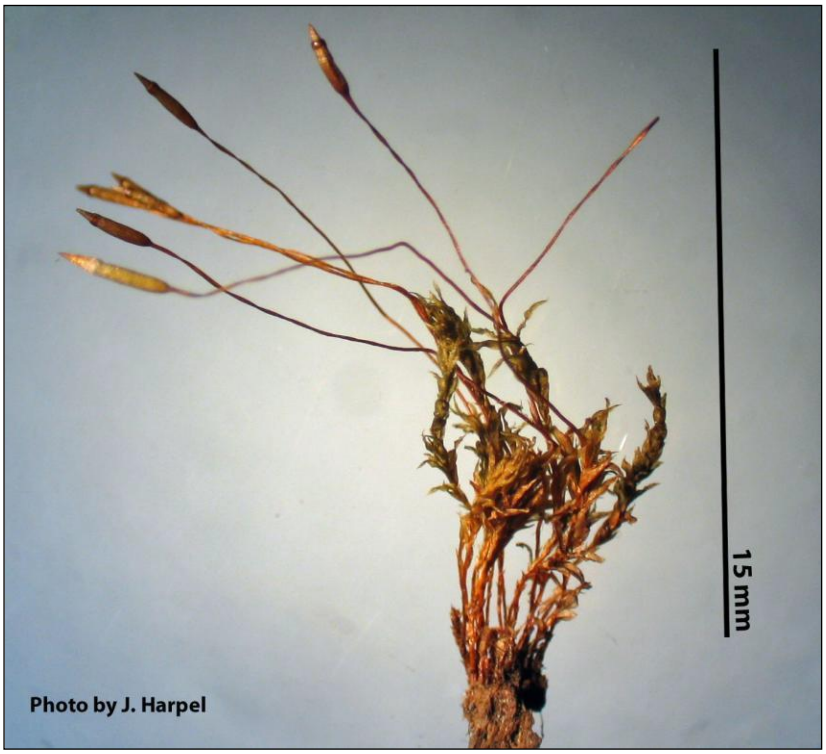
Attachment 1: Photos

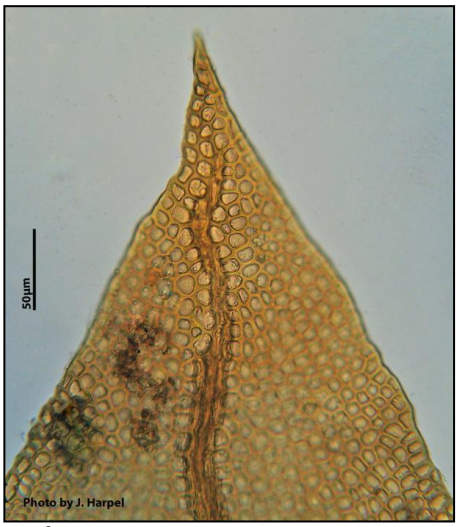
All photos by Dr. Judy Harpel, under contract with the Oregon/Washington Bureau of Land Management



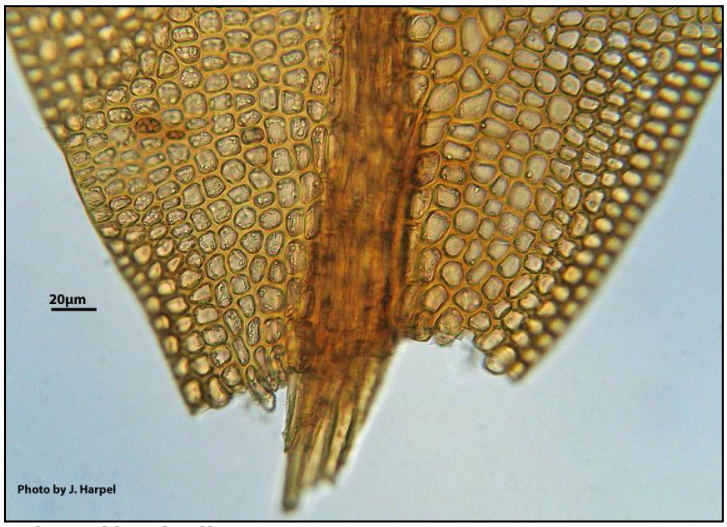
Whole mount dry

Whole mount wet

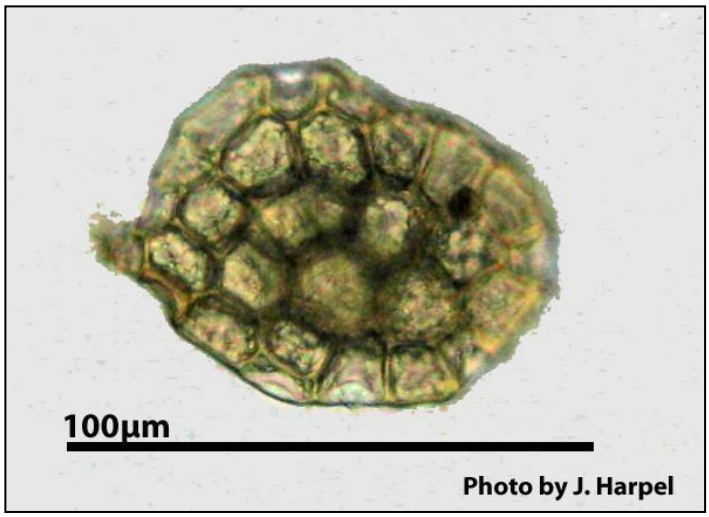
Leaf



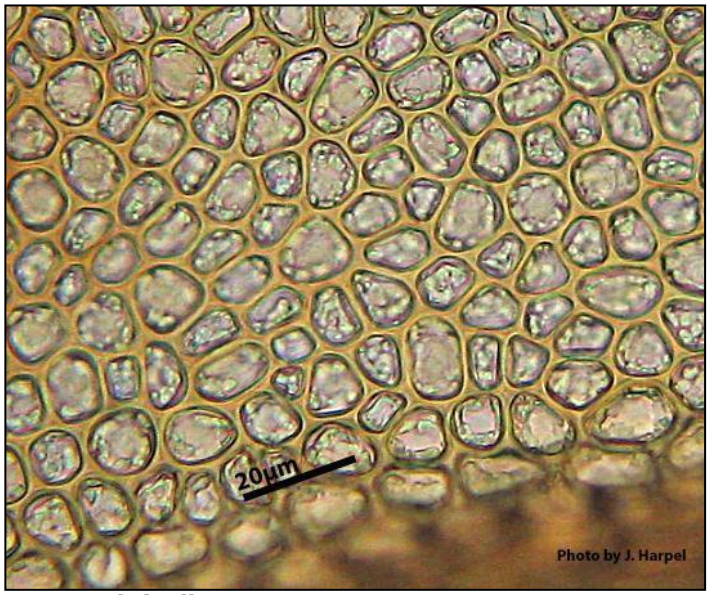
Leaf apex



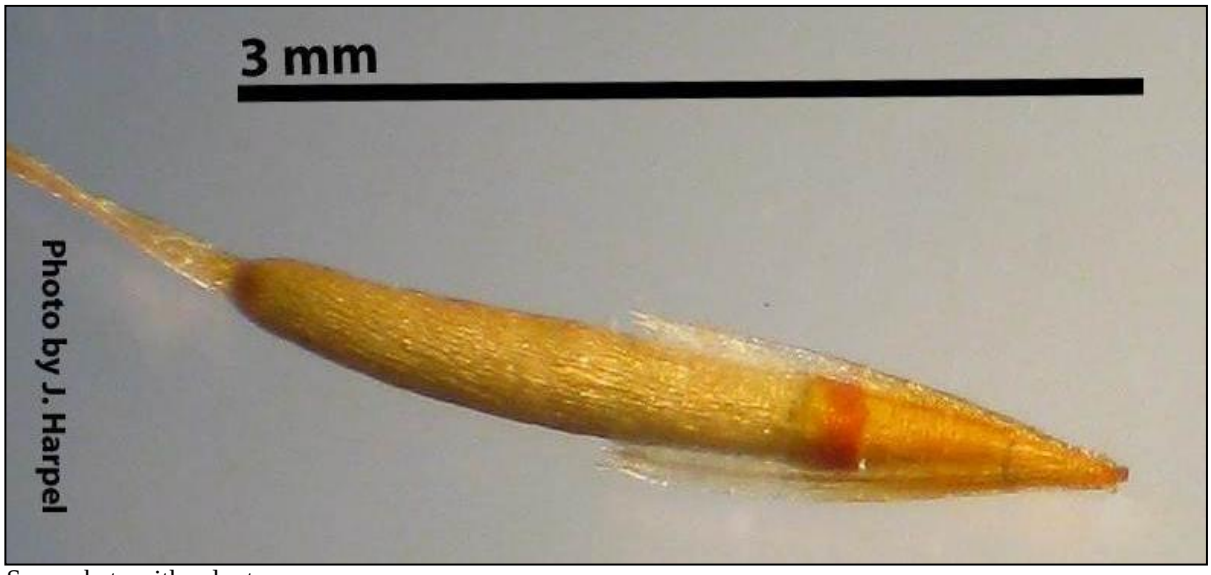
Alar and basal cells



Gemmae



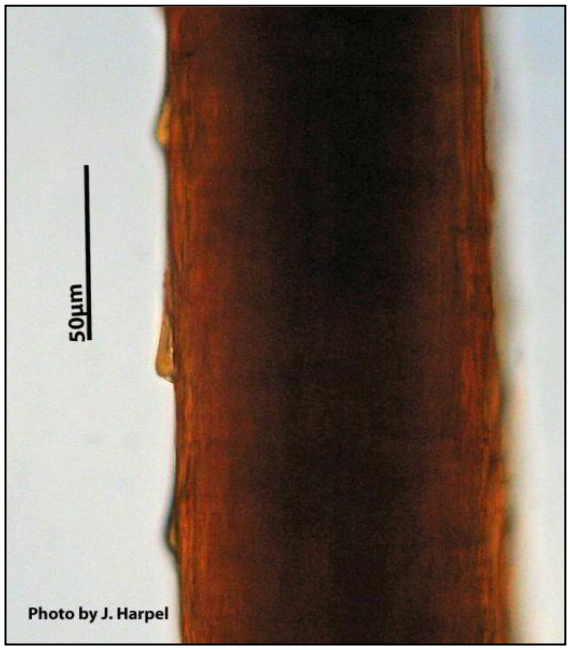
Upper medial cells



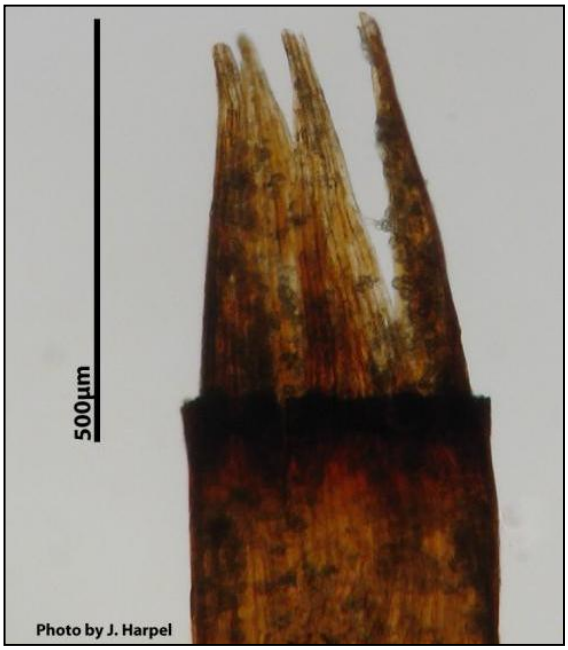
Sporophyte with calyptras

Gemmae cup

Mature sporophyte



Peristome teeth



Seta close-up